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ABSTRACT

This monograph for teachers addresses two emerging areas in the computing field--providing inservice training in microcomputer use for the general teaching population, and integrating the use of microcomputers into the overall curriculum. A brief discussion of why computers should be used in the classroom introduces five chapters which provide overviews of the following topics: (1) the use of computers in teaching and learning (areas of computer use and using the computer as a teaching/learning tool); (2) types of software available for schools (computer-assisted instruction software, applications software, and databases); (3) integrating computers into the classroom; (4) developing a plan for using computers in the classroom (setting up a classroom computer center and working with only one computer in the classroom); and (5) evaluating educational software (general questions, questions about instructional design, and questions about physical characteristics of the program). A concluding statement argues that the key to continued growth and expansion in the educational computing field lies with classroom teachers and urges them to take an interest in computers and begin to use this important new tool in their classrooms. A 71-item reference list concludes the document. (EW)

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Microcomputers and the Classroom Teacher

Gail A. Caissy

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by
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Table of Contents

Introduction 7

Why Use Computers in Education? 8

Using Computers in Teaching and Learning 11
- Areas of Computer Use 11
- Using the Computer as a Teaching/Learning Tool 12

Types of Software Available for Schools 15
- Computer Assisted Instruction Software (CAI) 15
- Applications Software 17
- Databases 19

Integrating Computers into the Classroom 21

Developing a Plan for Using Computers in the Classroom 24
- Setting Up a Classroom Computer Center 25
- Working with Only One Computer in the Classroom 27

Evaluating Educational Software 29
- General Questions 31
- Questions About Instructional Design 31
- Questions About Physical Characteristics of the Program 33

Conclusion 34

Bibliography 35

Introduction

When microcomputers were first used in schools almost ten years ago, educators were concerned with acquiring hardware. Computers were used mainly at the secondary level in a lab-type setting. The focus of the computer curriculum was on developing computer literacy and programming skills. And the teachers involved with computer education programs tended to be self-taught computer buffs or those with specialized training. Ordinary classroom teachers did not perceive themselves as part of the computer scene.

By the early Eighties, as more and more school districts had computers in place, educators' fascination with hardware began to fade; and the focus shifted to acquiring good software and to getting students exposed to computers at a much younger age in the elementary schools. Now with hardware and software in place and with a better understanding of the uses of microcomputers for teaching and learning, the focus has shifted to two new areas in the evolving education computing field: 1) providing inservice education in microcomputer use for the general teaching population, and 2) integrating the use of microcomputers into the overall curriculum.

This fastback will address these two areas, because until all teachers become familiar with and comfortable with microcomputers, the potential of this marvelous technology for teaching and learning will never be realized.

Why Use Computers in Education?

Will computers suffer the same fate as other technologies, such as radio and television, that were heralded as innovations that would revolutionize education but never lived up to their promise? Are they just another passing fad in education?

There can be little argument that the computer has brought about a revolution in our society, even though many people still have not accepted it. The invention of the microchip and subsequently the microcomputer are revolutionary because they put the high technology initially used only by scientists and specialized technicians into the hands of ordinary people. As a result, computers now are found almost everywhere and are used by people in many professions and many occupations. These are people without computer science degrees and without specialized training. These are people like you and me.

With millions of computers now in place in our society, we can safely assume that in one form or another they are here to stay. Almost every commodity involves the use of computer technology at some point in its production and distribution. The business and service sectors rely heavily on computers for their day-to-day operations. In fact, it is difficult to think of any sector of our society that is not adapting to and using this new technology. But what about the field of education?

This technology, which is having such a significant impact on the social and economic fabric of our society, cannot be ignored in our

schools. Students must become aware of the role of computers in our society, must learn basic computing skills, and must learn to use computers if they are to become effective and productive citizens now and in the future.

Computers also have catapulted us into the information age. This has changed the way we live and the way we work. Because lower labor costs in industrially emerging countries are making it difficult for us to compete with them in the world market, we are shifting away from a manufacturing economic base. Our economic strength in the future lies in developing and expanding the high-tech fields. As our economic base changes in this direction, jobs of the past are becoming obsolete. Many futurists predict that within the next decade, the majority of jobs in our society will be information/technology-based in some way. What does this mean for our students? Clearly, they must be prepared to work in an information/computer-based, high-tech society.

Although there is little doubt that the computer technology currently being used by students will evolve and change many times before they are adults in the workforce, it is important that they be exposed to the technology now and participate in its growth and change. Only then will they be comfortable with computers and thus avoid the technology phobia experienced by so many of our generation. Futurists predict that people will change jobs four or five times in their lives. If students are exposed to changing technology, they will be able to update their skills for jobs they will hold in the future – many of which are unknown to us today.

Many jobs in our society are already very dependent on computers, and more and more are becoming so. Examples include secretaries, stock clerks, bank tellers, librarians, and many others. Most students will need at least some computer-related skills in their future jobs.

Finally, computers can play an important role in the teaching/learning process occurring every day in our classrooms. Using computers in the classroom and integrating them into the curriculum not only

enhances learning but also simulates the way in which computers are used in society and in the workplace.

No, computers in the school are not a fad. They have become valuable tools for learning. However, the challenge facing educators is to ensure that the potential of computer technology for teaching and learning is fully realized.

10

Using Computers in Teaching and Learning

This chapter focuses on four areas of computer use in schools and considers the merits of the computer as a teaching/learning tool in the classroom.

Areas of Computer Use

Computer Literacy and Computer Programming. This area deals with the study of the computer, its functions, and skills for operating it. During the early years of computer use in schools, this area was the focus of computer courses taught mainly at the secondary level. This sole focus has waned significantly in recent years, but it continues to be one component of the junior/senior high school computer curriculum.

LOGO, a programming language developed by Seymour Papert for young children, is taught at the elementary level. Teachers often introduce LOGO in the context of their math or science curriculum. It is a simple form of programming, which younger students can readily understand and relate to; and it helps them to develop problem-solving and thinking skills. However, one must be familiar with the LOGO programming language in order to teach it.

Applications. This area deals with the use of computers as a learning tool. For example, using the word-processing functions of a computer to write a story is an application of the computer. The computer

is used as a tool to get the story into print form. Students are using it to assist them in a creative activity. There are many computer applications that can be used in various curriculum areas. By becoming proficient in various computer applications in school, students are prepared to use them when they enter the workplace.

Computer Assisted Instruction (CAI). As its name suggests, this area of computer use is for direct instruction and skill development. Software programs are available in various formats for many subjects and skill areas. Usually each program is designed for a specific instructional purpose (drill, practice, problem solving). CAI-type software programs can be used for many classroom learning activities.

Miscellaneous Areas. Computer programs also are available for such administrative functions as recording grades and attendance, for storing test questions, and for many other purposes. Programs also have been designed for use in business education classes and for enhancing existing software with the addition of graphics or music.

Using the Computer as a Teaching/Learning Tool

The computer is a classroom tool that can enhance and improve instruction and learning. It should be used to complement and supplement the curriculum and should not require a revamping of the curriculum to fit the computer. It is not intended as a substitute for a teacher. The computer is intended to assist teachers with instruction and students with learning.

The computer has some unique advantages as a teaching tool. With well-designed and pedagogically sound software, students can work independently of the teacher, for example, on drill and practice exercises. Of course, such exercises can be done with workbooks; but the computer allows students to get instant feedback. They know immediately whether the answer is right or wrong. This instant feedback is important because it allows the student to correct incorrect responses before they become habitual. And because the computer

is patient, it encourages the student to keep trying. The computer also can track such things as the number of questions a student has answered, the number of errors made, and in some instances the type of error made.

Computers provide for a certain amount of individualization because students can work at their own pace. They can take whatever time they need to review instructions for a lesson and then proceed when they are ready. Many programs have several levels of difficulty built in, thus providing for another level of individualization.

Good programs are interactive; that is, they provide for student input and computer feedback, which keep students continuously involved in the learning process. Computer programs can provide a greater variety of questions and more randomization of those questions than is possible with a textbook or blackboard exercise. The computer also has the ability to store information in a way that allows students to access only the information that is relevant to the task at hand.

Computer programs also have the ability to simulate a process that is often difficult to demonstrate in any other way. For example, students can observe the process of cell division or view the human circulatory system in motion on the computer screen. Such simulations are particularly useful for science and social studies lessons, as well as for other curriculum areas.

Computer programs also can be used to develop or improve thinking skills. By using simulation, problem-solving, and discovery-oriented programs, students use a variety of thinking skills in making judgments and decisions called for in the program. By immediately seeing the results of their decisions or judgments, students can determine for themselves whether they were good ones or poor ones.

While working with computer programs, students learn many computer-related skills, such as word processing. They become familiar with the computer keyboard and with the functions and capabilities of the computer in general – all while involved in the day-to-day learning activities of the curriculum. Students also learn

to follow directions carefully as they carry out the precise instructions required to make the program work.

Finally, computers themselves provide a form of motivation for students that other teaching aids cannot match. The vivid colors and graphics, the appealing screen designs, and the experience of seeing their own names on the screen stimulate students to want to learn and to master the program content. With such motivation, students find learning more enjoyable.

Types of Software Available for Schools

There are literally thousands of educational computer programs on the market today. Each has its own instructional purposes for various subject areas. This chapter will examine categories of software appropriate for teaching particular skills or subject matter.

Computer Assisted Instruction Software (CAI)

CAI software for language arts, mathematics, science, social studies, and other areas is available in various formats. Some of the more common formats are described below.

Drill and Practice. With this format students perform straightforward question-and-answer type exercises and get immediate feedback. An example of this format is an exercise for practicing basic addition and subtraction combinations.

Tutorial. With this format students are introduced to new information or processes in a step-by-step fashion. Activities or exercises that may accompany these programs provide practice and reinforcement in using this new information or process. An example of a tutorial is a program for learning the location of the states and their physical features on a computer-generated outline map of the United States.

Simulations. These programs generally come in two formats. In the first format, students assume the role of a person with a particular goal to accomplish. For example, the student may assume the role

of an urban planner who is charged with designing a new city. When doing the simulation activity, the student uses the same principles that real urban planners use; and in the process they learn what urban planning is all about. In the second format, students observe or experience processes as they might occur in real life. For example, they might observe a scientific experiment on magnetism on the computer and then follow up by applying some of the principles of magnetism they have learned to answer questions in accompanying exercises or activities.

Problem Solving. As the name suggests, with this format students are given a situation in which they must make a decision or find the answer to a problem using the information provided. Some of these situations are programmed so that as the students work their way toward a solution or decision, the computer assists them in the decision-making process. For example, students may be asked to locate the whereabouts of a hidden treasure using clues given, or they may be asked to improve the standard of living in a Third World country using economic information provided.

Discovery Learning. In this format students learn new facts and concepts in a learning-by-doing, self-correcting mode. The computer program might then present activities in which students can apply the facts and concepts learned. An example of a discovery learning program activity is one in which students experiment and discover what happens when certain chemicals are combined to create new substances.

Educational Games. Programs in this format use games or other fun-oriented activities. They may or may not address a specific skill or subject matter and may or may not have much educational significance. These programs can help to develop various social skills when played with other students. An example of a game-type program is playing tick-tack-toe on the computer by correctly responding to various number facts.

Self-Authored. This format is open-ended and allows the user to create an individualized program. These programs are available in

a variety of formats, such as a game, database, or drill and practice exercise. The user enters data on any subject or area of interest, and the computer automatically formulates the activity intended. An example of a self-authored program is a spelling game in which students can practice their spelling words. Students can enter their new spelling words each week and practice them until they are mastered.

Most CAI software programs fall into one of the formats described above, although some use a combination of formats. Teachers should select the program format that is most appropriate for the desired instructional goal.

Applications Software

Word Processing. The computer's word-processing functions include the entry, manipulation, editing, and storage of text. While these functions are somewhat similar to those of a typewriter, the advantage of the word processor is that the text being entered can be saved or stored, and parts of it can be changed or moved around without having to retype the entire text. Once in the memory, single or multiple copies (hard copies) can be printed of any or all portions of the text. Word processors are now used extensively in business, and in many offices they have almost replaced the conventional typewriter.

In school students can use word processors to write essays, stories, and reports. There are also software packages with formatting and graphics features that students can use to create their own newspaper or newsletter, illustrated stories, fliers, and brochures.

There are several advantages to using word processors in school. Simply using the word processor is highly motivating to a lot of students, especially reluctant learners. They also are learning a valuable skill that has many applications outside the classroom. Students can edit and revise their compositions without the need for retyping multiple drafts. And students' compositions have a professional look when they come out of the printer.

Using word processors in school also presents some problems. Students must be familiar with the basic operation of a computer and must have reasonable typing skills. If they have to "hunt and peck" on the keyboard, the composing process can be frustrating and tedious. Keyboarding skills should be taught directly before students undertake a major writing project on the word processor.

Another problem is that most classrooms do not yet have enough computers for several students to work on word-processing projects at once. As a result, time to practice on the word processor is limited and sporadic. Without access to multiple computers in the classroom or a computer lab in the school, class time must be restructured to accommodate the students who want to work on the word processor. A related problem is access to a printer. Often a printer has to be shared with other classes or teachers, which results in students wasting time at the printer waiting for their copies to be printed.

Some teachers have observed that when students compose on the word processor, they tend to do only superficial editing related to spelling, grammatical, and typing errors rather than doing the kinds of revisions that would improve the style and organization of their writing as a whole. Some of this student obsession with mechanical correctness probably can be attributed to the ease with which such corrections can be made on the computer. Also, since some teachers tend to over-emphasize mechanics to the neglect of more important aspects of the writing process, it is not surprising that students might respond to those kinds of expectations. When writing is taught as a process where revision is expected, the word processor becomes a valuable tool for students. (See fastback 256 *A Model for Teaching Writing: Process and Product* and fastback 254 *Teaching Writing with the Microcomputer*.)

Another concern of teachers is that if younger children spend too much time on the word processor, they may not get enough practice in handwriting during those years when such skills are developed for life.

Databases

A database is a collection of information that is stored in the computer. Databases are used extensively in business for keeping track of records, transactions, inventories, accounts, and many other purposes. Whenever information needs to be stored in an organized form, a database is used. In schools two kinds of databases are commonly used. The first is stored information such as might be found in an encyclopedia or dictionary. By learning how to use the computer's thesaurus or key words, students are able to locate the information they need. The second is a student-created database on a specific topic for a specific purpose. To create their own databases does not mean that students must know how to program a computer from scratch. There are many "shell-type" programs available that provide the basic structure of the database. The student's task is to gather and enter the information in the shell format provided by the program.

Students and teachers can use databases in the classroom for many purposes. But first students must understand what databases are and how they are used, for example, in such businesses as banks, insurance companies, and department stores.

As an individual or class project, students might create their own databases on a particular topic, such as famous world explorers, snakes of the world, favorite sports heroes, etc. In the process of creating a database, students learn how to do research and how to organize information in various ways – alphabetically, chronologically, topically – so that it can be retrieved later. These databases can be used for reference by class members or by other classes at a later date.

Existing databases can be used to teach students research skills. For example, in a database that has thousands of entries, students must learn how to access the specific information they might need to write a report. Or teachers can ask students to answer questions using information available in a specific database to develop thinking skills. For example, in a database on the animals of the world, the teacher

might ask students to identify common traits of certain species of animals. In a database on countries of the world, the teacher might ask students to explain the relationship between a country's climate and its location on the Earth. The information in a database also can be used for higher-level, problem-solving activities. For example, using information in a database on economic conditions of major U.S. cities, a teacher might pose this problem: In which of these five cities would it be best to build a new auto factory? What economic factors should you consider in making your choice?

Databases are versatile reference sources. Once students learn how to access information from them, they can serve as a resource in much the same way as an encyclopedia or textbook.

Integrating Computers into the Classroom

Computers can be used to support the teaching of skills and content directly related to the curriculum, or they may be used to further other important educational objectives not tied to specific subject matter. For example, they can be used for practice in thinking skills, such as problem solving and decision making, and for doing research. This chapter will discuss various ways of integrating computers into classroom learning activities.

Reinforcement. Software programs, in the form of review exercises and activities, are available for reinforcing skills and content taught in the classroom. Drill and practice programs might be used for skills and tutorials for reviewing content. Many programs used for reinforcement purposes allow students to work independently of the teacher.

Remediation. Closely related to the programs used for reinforcement are software programs that can assist with remediation by providing repeated practice for students who are having difficulty mastering certain skills or concepts. Research has shown the benefits of using computers with low achievers. Because computers are ever patient, uncritical, and self-pacing, slower students like to use them. The students not only make significant gains in academic achievement but also improve their self-concepts.

Enrichment. For brighter students who need a challenge or for those who complete assignments ahead of others, there are software pro-

grams that can be used for enrichment activities. Programs selected for enrichment purposes should relate to specific student interests, which may not necessarily be on topics covered in the standard curriculum. Some of the discovery-learning programs would be appropriate for these students.

Reward. The computer is an exceptionally good motivator, so sometimes a teacher might use time on the computer as a reward for some achievement. When used as a reward, students might be allowed to play educational games alone or in small groups, or they can be allowed to select a program based on their individual interests.

Interest Center. When a classroom has only a single computer, it can be used as one of the interest centers along with the reading corner or the science corner found in many classrooms. Such an interest center helps to build computer awareness as students become familiar with the functions and capabilities of the equipment. Posters, such as a diagram showing the parts of the computer and their names, can be displayed. Also, during units covered in the curriculum, such as weather or animals, the teacher can provide programs on these topics for students to use at the interest center.

Teaching Tool. Teachers can use the computer directly as a teaching tool, for example, by showing the class the process of cell mitosis on the computer screen. Or a teacher can create a game on the computer by using new vocabulary from a story in reading class and having students match words with their definitions. Computer software also can be used to support or supplement other instructional media.

Research Skills. With the availability of several databases, teachers can show students how to do research using a computer. After students learn how to access, locate, and retrieve information from a database, they can follow up by classifying and organizing the information for a group project or an individual report.

Thinking Skills. There are at least three dimensions of thinking that a student can use when working on a computer. First, students gain

practice in thinking in a logical, linear fashion because the computer program will not run unless the directions are followed in a sequential and precise manner. Second, there are many software programs designed especially to promote creative thinking. They allow students to input their own ideas into the program and then to use those ideas to solve problems, design graphics, or create music. Third, students gain practice in using many higher-level thinking skills, such as problem solving, decision making, and analyzing, in simulation programs. Whether the content of such programs is in science, geography, history, or any other area, is not as important as the thinking processes the student must engage in to complete the simulation or activity. Because of the computer's ability to store and organize large amounts of data, relatively complex problems can be designed into programs that develop thinking skills.

Cooperation and Group Work. Many software programs are designed so that students can work in pairs or in small groups on exercises, simulations, or problem-solving tasks. Such programs provide opportunities for students to work cooperatively and to practice such group skills as taking turns, brainstorming, listening, and sharing ideas.

Classroom Administration. Besides using computers to supplement the curriculum, teachers can use a computer for several administrative purposes in the classroom. Examples include records of student grades and attendance, student projects, test scores, and test items.

23

Developing a Plan for Using Computers in the Classroom

This chapter will discuss several factors a teacher should consider before initiating the use of computers in the classroom. These factors appear below as a list of separate questions, but they should not be considered in isolation because they are closely interrelated. Thoughtful consideration of each of these questions before implementing computer use in the classroom will help to make the effort much easier.

1. Does the school district have existing policies or guidelines for using computers in the classroom? If so, then they should be reviewed by teachers planning to implement a program in order to be in compliance with them. If not, then teachers will have to structure their computer implementation plan the way they think will be most effective.

2. Have the students used computers before? Their previous experience will determine whether a teacher starts with the basics or builds on computer skills already learned.

3. Have teachers thought through how computers can best be used for a particular grade level or ability level? What curriculum objectives will be served by the use of computers?

4. In what subject area(s) will the computer be used? Across the curriculum or in only a few subject areas? In what areas can computers best be used to supplement the existing curriculum?

5. Will computer use be integrated into regular lessons? Or will it be a separate activity devoted to learning basic computer skills?

6. Will computers be available in the classroom on a permanent basis? Or will they be housed in a separate computer lab requiring that the class be taken there on some scheduled basis?

7. After teachers decide how computers will be used in the classroom, what kinds of software will be required? Is the required software available in the school district? If not, are funds available to purchase it? It may turn out that computer use will have to be restricted to available software. This is an important consideration that should be investigated before elaborate plans are made.

8. How much time in the overall class schedule can be devoted to computer use? How will this time be organized so that all students can participate?

9. Are there students with special needs who would benefit more from using the computer than others? Is any special software needed for these students? Is it available?

10. What means of evaluation will be used to determine whether the computer program in the classroom has been useful or successful? How will this be reported to administrators and parents?

These 10 questions can serve as the basis for the first phase of planning. With the answers in hand and decisions made, the next planning phase is setting up a classroom computer center.

Setting Up a Classroom Computer Center

The computing center is best located along a wall where power outlets are available. This avoids stringing electrical cables across the classroom where students might trip on them. Older classrooms with only a single power outlet on a wall may present a problem. However, an inexpensive power bar can provide multiple electrical outlets for the hardware.

The computer center should be easily accessible to students but out of the way of heavy traffic areas in the classroom. This will avoid

disruption from students moving about the classroom and minimize jostling of the hardware. The computer center should be in clear view of the teacher so that student activity can be monitored without the teacher having to walk over to the area.

The area should be well lighted; but avoid placing it too close to a window, which might cause excessive glare on the computer screen. Drapes on the windows can help to control the glare. Keep the computer center away from sinks to avoid any water being splashed on the hardware. Also avoid dusty areas near a chalkboard or heat vents and areas exposed to excessive temperatures such as in direct sunlight or near heat vents. It is preferable that the area not be carpeted because static electricity sometimes causes computer malfunctions.

There are many styles of furniture specially designed for computer equipment. But if funds are not available to purchase this furniture, a large table can be used. Depending on the size of the students, the table legs might have to be shortened. Proper height for working comfortably on a computer is similar to that for typewriters, that is, a bit lower than normal table height so that the arms do not have to be elevated above one's elbows to use the keyboard. There should be ample space on the table for the computer components as well as for a student's notebook, instruction manual, etc.

Software needed for the computer center can be kept at the center or at the teacher's desk. For younger students, teachers may want to maintain control over software dispersal. Older students usually can take responsibility for the software themselves. However, there should be a system for keeping track of what software is out and who is using it. A sign-up sheet or a card system similar to those used in libraries for books can be used to keep track of the software. Software should be filed alphabetically or by topic so students do not waste time finding the program they need.

Attractive posters with standard computer information can be placed on the walls near the computer center. Having this information where students can easily refer to it helps to avoid teacher interruptions from

students who have questions. The posters could include information or diagrams on how to load a program, reminders about the steps to follow with the computer menu, care of disks and hardware, and rules for working at the computer.

Working with Only One Computer in the Classroom

Having only a single computer in the classroom presents certain organizational and management problems for a teacher. Despite the limitations a single computer imposes, with careful planning a teacher can provide students with many opportunities to learn about the functions of the computer and to use it to enhance their learning experiences.

If students have had no previous experience with computers, the teacher must first prepare a series of lessons to introduce them to the computer. This will involve teaching the components of the computer and computer terminology, demonstrating how to start and load the computer, and giving suggestions for the care and maintenance of the equipment. Also, rules for the use of the computer should be established and discussed with the class. They then should be posted near the computer as a reminder for students. Sufficient time spent on orienting students to the computer will avoid the need to answer endless questions about its operation once the students start to use it.

Scheduling time on a single computer so that all students will have an opportunity to use it requires careful planning. Since only one, a pair, or a small group of students can use it at a time, some type of scheduling is essential. A laissez-faire policy of letting students use the computer when they have finished their work and have free time is bound to result in arguments as to whose turn it is. And a few students are likely to end up using the computer most of the time. A better policy is to block out a schedule for a certain amount of time, say 20 minutes a week, for each student to work at the computer, but avoiding core subjects whenever possible. The schedule may have to be rotated so that students do not miss the same subjects repeatedly.

27

During non-class time such as after school, a sign-up sheet can be used for scheduling computer time.

The day is not too distant when all students will have more access to computer terminals in the classroom. But until that time comes, teachers will find ways, as they have always done, to use existing resources to enrich the learning of their students.

28

Evaluating Educational Software

Educational software has improved tremendously over the last decade. Because many of the early software programs were developed without input from educators, they often violated sound pedagogical principles. As educators became more involved in the development of software, and because the market was demanding better programs, the quality has improved. Now with thousands of educational programs on the market, teachers face the task of deciding which ones to use in the classroom. Software evaluation has become a major task for all computer users, but it is especially important for educators.

Fortunately, there are now several sources to consult about software evaluation. Obvious sources are fellow teachers who have been using software for some time and the district computer-education coordinator, who is likely to be well informed about the best and the most up-to-date software available. Other good sources are reviews of software published in various computer journals (see the list of journals in the bibliography). Also, by attending computer conferences or workshops and visiting software publisher exhibits, teachers can learn much about various types of software and how they can be used.

Several nonprofit organizations provide software evaluations to educators. Two examples are Education Products Information Exchange Institute (E.P.I.E.) in Water Mill, New York, and York University Data Base in Toronto, Canada. Educators who are knowledgeable

about software do reviews for these organizations on a regular basis. These reviews usually provide such basic information as the type of computer for which the software is designed, price range, and the publisher's name and address. This is followed by a brief summary of the program, its learning objectives, and its strengths and weaknesses. Often the software package or a component of it is given a numerical rating as a means of comparing it with others on the market. These reviews usually are available in print or through on-line computer access.

One problem with published reviews is the long time lag between the release of a new software product and the publication of a review. Teachers may not want to wait until reviews are published before using a program. Another problem is that a reviewer tends to write for a general audience and can overlook needs of individual school districts or teachers. For example, a reviewer may give a program a poor rating because it is too drill-and-practice oriented, even though this type of program may be exactly what a teacher is looking for. There is also the problem of reviewer bias, which may not become apparent until one has read several reviews by the same reviewer. Nevertheless, published reviews are helpful because they provide a concise overview of the program and usually provide enough information for teachers to determine whether they want to consider using it. They serve as good filters when having to make a choice from among several software packages.

Another level of software evaluation is often done by school districts in order to develop a recommended list for teacher use or for purchasing decisions. A common practice is to have the district computer coordinator organize a software evaluation committee whose job is to develop a recommended list of software from which teachers can choose. The committee publishes its reviews, which then are distributed to all teachers in the district. This level of software evaluation is more likely to reflect the district's philosophy of computer use in the curriculum.

Ultimately, the decision as to what software to use rests with the classroom teacher, who knows the students' skill and content needs and knows their ability level. Just as any instructional materials should be previewed before they are used, so should software be previewed to determine its appropriateness for classroom use. What should a teacher look for when reviewing and evaluating software? The following sets of questions should prove helpful.

General Questions

1. For what purpose will the software program be used: to reinforce, to remediate, to teach new concepts, to provide enrichment, to supplement materials being taught, to develop computer literacy, to use as a reward, etc.?

2. What is the grade level and ability level of the students who will use the program? If the software under consideration is not appropriate for the developmental level of the students, it is unlikely that it can be used successfully.

3. What are the instructional objectives of the software? Are these objectives clearly stated in the accompanying literature, and does the program meet its stated objectives? Many programs fall short in this respect because they fail to follow sound principles of pedagogy and instructional design; they are not organized logically and sequentially. In other cases, the learning tasks presented in the program are inappropriate to help students meet the stated objectives.

4. What knowledge or skills must a student possess in order to use the software program successfully? For example, must a student know a particular mathematical formula, understand a certain scientific theory, or be able to read music in order to use the program successfully?

Questions About Instructional Design

1. Is the instructional design sound? That is, does the program adhere to fundamental principles of teaching in terms of logical organi-

zation and sequential development? Since students cannot question a computer as they might a teacher, it is critical that the program design and requirements be absolutely clear to students.

2. Is the program suitable for the ability level of the learners using it? Are the skills and materials covered appropriate to the specific learning needs of the intended users? Is the vocabulary in the program's text at a level the target age group can understand without resorting to a dictionary? Another factor to consider is whether students at various ability levels can use the program.

3. Are the instructions in the program clear to students? Again, because students cannot ask the computer specific questions, the instructions must be simple and cover limited points at a time. Long, complicated instructions often divert the students' attention from learning the intended skills or content because they spend an inordinate amount of time trying to understand the instructions.

4. Who is in control of the program, the student or the computer? The student should be in control of the program at all times and be able to progress at his own pace. The program should have the capability to loop back to any part in case the student needs to review instructions or content presented earlier. It also should have an exit option that allows a student to quit the program at any point.

5. Is the reinforcement appropriate? Computers can be wonderful motivators if reinforcement is delivered in a positive manner. The software program should provide generous praise for correct answers but none for incorrect ones. In some early programs, the computer's response to an incorrect answer was more rewarding to a student than the response to a correct answer.

6. Does the program spark the interest of the target audience? Is the program design (manner of presentation, reinforcers, graphics, music, etc.) appealing to the age group for which it is intended?

7. Does the program provide a record of student progress? Such records are useful to students for assessing their own progress and useful to teachers for determining whether students are meeting the

goals of the program. Progress records serve as a diagnostic tool for determining which students need additional help.

8. Is the program making full use of the technology of the computer? A computer that functions only as an electronic page turner is not using its potential. Whether a software program is intended to teach skills or to convey information, it must be interactive, not passive viewing of information as in watching television. It must involve students in their own learning.

9. Does the program avoid unnecessary computer jargon, and is it free of spelling and grammatical errors and inaccurate information? Some programs contain errors of this nature because of poor editing and insufficient field testing.

Questions About Physical Characteristics of the Program

1. Is the on-screen print clear and easy to read? Does the use of color, graphics, and music help or hinder the learning process? These evaluations can be made after a visual inspection of the program's instructional screens.

2. What is the life expectancy of the program? Can it be used over and over by the same student? Does the program contain large amounts of material that will quickly become dated? Is the program suitable for a wide variety of learning situations (an important consideration when software budgets are limited)?

3. Is the loading procedure or load command code (for those computers that require one) simply explained in the instructions that accompany the program? Programs for some computers will not run until the user types in a specific load command; therefore, the load command should be easily accessible and the instructions should be explicit.

4. Are the operating instructions in the user's manuals easy to understand? Are support materials appropriate and well organized?

The questions listed above may not cover every aspect of software evaluation, but they should serve as a general guide for the evaluation process.

Conclusion

In our high-tech information society we are becoming more and more dependent on computers in every sector of life. Computers will be one of the most important tools our students will need to function in this society; and they will use them extensively in shaping the world they will soon be leading. Educators cannot ignore the pervasive influence of computers in our society. We must begin now to prepare students for life in a computer-oriented world.

The key to continued growth and expansion in the educational computing field lies with classroom teachers. Without their involvement and cooperation, the best computer hardware and software in the world will make little difference. Only when an increasing number of teachers take an interest in computers and begin to use them in their classrooms on a regular basis will their impact be felt across the nation.

We now have had enough experience to know that computers are not going to take over our classrooms or put teachers out of their jobs. They are only a tool, requiring skillful and committed teachers to make them work as an adjunct to the curriculum. Teachers must put aside their phobias about computers and get on with the task of using them to enrich student learning. We must begin now to develop the skills and knowledge needed by a new generation of students. The future is now.

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